REMARKS

The Applicant respectfully requests reconsideration of the rejections set forth in the official action in view of the foregoing amendments and the following remarks.

35 USC 112, Second Paragraph: Claims 1 and 8

The Examiner rejected Claims 1 and 8 under 35 USC 112, second paragraph. In making the rejection the Examiner indicated that Claims 1 and 8 contain the term "substantially". The Examiner further explained that the term "substantially" is not described in the application. Therefore, the Examiner concluded that Claims 1 and 8 are indefinite because the scope of the invention can not be reasonably determined from the claims.

In response to this rejection, the Applicant notes that the Examiner was apparently able to determine the scope of the subject matter set forth in Claims 1 and 8 in order to devise and perform a search of the prior art. Indeed, one of the references found by the Examiner has been cited against the novelty of the Applicant's claimed system and method as set forth in Claims 1 and 8 respectively. Therefore, it appears that those claims are not so indefinite that they do not reasonably meet the requirements of the second paragraph of Section 112. Accordingly, it is believed that the rejection is improper. Moreover, in view of the amendments to Claims 1 and 8, it is believed that the rejection is moot.

35 USC 102(e): Claims 1, 3-5, 8, 10-15, and 18-20

The Examiner rejected Claims 1, 3-5, 8, 10-15, and 18-20 under 35 USC 102(e) as being anticipated by US Patent No. 5,812,674 (Jot et al.). The Applicant respectfully traverses this rejection for the following reasons.

<u>**Claims 1 and 8**</u>

Claims 1 and 8 as amended define a sound system processor and method, respectively, for providing early reflection enhancements in a sound system which are novel and inventive over the system described in Jot et al. More specifically, Claim 1 is directed to a sound system processor for providing in-line early reflection enhancement and Claim 8 is directed to a method for enhancing acoustics using a sound system processor. The Applicant's claimed sound system processor includes a plurality of inputs or microphones, a plurality of loudspeakers, and an early reflection generation stage which generates a plurality of delayed, discrete reproductions of the input signals. The delayed discrete reproductions of the input signals are broadcast by the loud speakers into a room or other space. The sound system is defined by the combination of the claimed sound system processor and a room or other space.

The early reflection generation stage as set forth in Claims 1 and 8 includes a cross-coupling matrix and has a *unitary transfer function matrix* such that the *sound system processor has an overall power gain that is substantially constant with frequency to improve stability in the sound system.*

The method and apparatus described in Jot et al. does not describe a sound system processor that has an early reflection stage having "a unitary transfer function matrix such that the sound system processor has an overall power gain that is substantially constant with frequency to improve stability in the sound system". Rather, the Jot et al. patent describes a system for simulating the acoustic quality of a virtual sound source in a virtual room. In essence, the reference describes a digital reverberator for use in simulating a virtual environment. The output of the digital reverberator can be panned to control the localization of sound in a room. A large part of the patent discusses the generation of the various parameters used in the reverberator and so is not relevant to the present rejection.

The system and method described and shown in Jot et al. provide reflections and reverberations that are combined together to provide the output signals to the loudspeakers. The functions of the various subcomponents of the Jot et al. system are combined such that the transfer function of the system processor is not unitary overall. Moreover, the system described in Jot et al. does not have an overall power gain that is substantially constant with frequency. In other words, at each frequency the total power at the outputs C, L, R and S1 –S4, if divided by the total power at the inputs to the system processor would not be substantially constant with frequency. This means that if the system processor were used in a sound system employing microphones and loudspeakers, the stability of the sound system would not be improved. That result is contrary to the purpose of the Applicant's claimed invention as set forth in Claims 1 and 8.

The Applicant's claimed sound system processor as set forth in Claim 1 and the Applicant's claimed method as set forth in Claim 8 provide an early reflection output with total power equal to the total input power, and an overall power gain in the sound system that is substantially constant with frequency. When the Applicant's claimed sound system processor is used in a sound system, the stability of the sound system is improved and the risk of artificial coloration of the sound is significantly minimized.

It is first worth noting, that even prior to the amendment, the claims described an early reflection generation stage that was novel and inventive over the sound processing room module shown in and described with reference to Figure 9 of Jot et al. Although Jot et al. shows an input which is fed through delay lines (731) and then a unitary mixing matrix (741), the outputs of that unitary mixing matrix (741) are not directly output to loudspeakers. Therefore, at no point in the operation of the system described and shown in Jot et al. are signals output from the system which are generated by an early reflection enhancement stage that (i) has a unitary transfer

function matrix and (ii) that provides an overall power gain in the system that is substantially constant with frequency. Rather, the outputs taken from the unitary mixing matrix (741) are further coupled together (after delays 742) to produce a non-unitary output which results in the system output. The system outputs are generated such that the system output power gain is not constant with frequency because of the additional signal processing performed on the outputs of the delay line (731) and on the outputs of the unitary mixing matrix (741).

More specifically, referring to Figure 9 of Jot et al., if the delay line 731, the unitary matrix 741, the delay line 742 and the combined outputs R2 are considered an early reflection enhancement stage, the overall subsystem producing this does not have a unitary transfer function matrix with an overall power gain that is substantially constant with frequency. The outputs R2 are produced from combined outputs of the matrix 741 through the delay 742, resulting in a non-unitary characteristic.

If one considers the delay line 731 and the unitary matrix 741 to be an early reflection enhancement subsystem, then there are no subsystem outputs from the unitary matrix that are sent directly to the system output. Therefore, while this portion of the subsystem might arguably be unitary, the output (delayed discrete reproductions of the signals) is not sent to a number of loudspeakers (or otherwise broadcast into the room). Sending the reproductions as the ultimate output to a number of loudspeakers or alternatively broadcasting them into a room is a novel feature of the claims of the present invention. In the apparatus described in Jot et al., the only output that might be sent to a loudspeaker or broadcast emanates from a subsystem (such as delays 731, 742 and matrix 741) that does not have a unitary transfer function matrix.

Further, Claims 1 and 8 as amended are directed to a sound system processor that includes an early reflection generation stage. This provides early reflection enhancement in a sound system. The sound system would typically include a sound

system processor and the room in which it is utilized. The room provides feedback from the outputs (e.g., loudspeakers) to the inputs (e.g., microphones). Accordingly, the amended claims provide a further inventive feature relative to Jot et al.

The early reflection generation stage that is a feature of the Applicant's claimed sound system processor and method has a *unitary transfer function matrix* such the *sound system processor has an overall power gain substantially constant with frequency to improve stability in the sound system.* When the claimed processor is used, it provides significantly improved stability because the unitary early reflection stage does not increase the loop gain of the sound system at any frequency. The sound processing room module shown in Figure 9 of Jot et al. does not have a unitary transfer function matrix that provides stability in the sound system overall by way of a power gain that is substantially constant with frequency. Each of the outputs of the sound processing room module of Jot et al. are formed in a manner such that none of them meet the requirement of having a total power gain that is substantially constant with frequency to provide stability in the sound system. That is, the overall transfer function of the sound processing room module of Jot et al. is not unitary, the power gain is not substantially constant with frequency, and the disclosed module does not improve stability of a sound system. An output by output discussion of the Jot et al. sound processing room module is presented to support this argument.

The Outputs L and R

Referring to Figure 9 in Jot et al., the equalized room signal is fed into a delay line 731 that produces multiple reflections ($t_1 - t_N$). The delayed outputs are combined in amplifiers 732 with odd and even outputs summed left and right respectively, to provide equalized outputs L and R in amplifier 733. The two-by-one transfer function sub-matrix from the input "ROOM" through to the outputs "L" and "R" is non-unitary. Therefore, the Jot et al. apparatus with respect to outputs L and R does not have a

unitary transfer function matrix, nor does it have an overall system gain that is substantially constant with frequency.

Output Signals S1-S4.

The delayed outputs $t_1 - t_N$ are also cross-coupled by means of a first unitary matrix 741 and the outputs of the first unitary matrix are further delayed by additional delays $\tau'_1 - \tau'_N$ in delay ban 742. The delayed outputs are summed into pairs and then fed through an equalizer R2. The resulting delayed output signal are generated using the following output summing matrix.

$$A = \begin{bmatrix} 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \end{bmatrix}$$

The matrix transfer function from the inputs to matrix 741 to the outputs from R2 is not unitary as a function of frequency. Therefore, in considering the system in relation to outputs S1-S4, the section of the room module that generates those outputs does not have a unitary transfer function and the overall system producing those outputs does not have constant power gain with frequency to provide stability.

Reverberation Components of S1- S4

The delayed signals τ'_1-τ'_N are also input to a second unitary matrix 744. The outputs of the second unitary matrix are delayed further (τ_1-τ_N) and fed back to the inputs of the unitary mixing matrix 744 to produce reverberation. The outputs of delays τ_1-τ_N are summed into four channels resulting in R3 and then added to the four other reflection signals R2. The sub-matrix from the unitary matrix 741 to the signals R3 is not unitary. The R3 signals are added to the other reflection signals R2 to produce a

sum of non-unitary sub-matrices which are also non-unitary.

In conclusion, neither the overall system nor the sub-systems thereof described in Jot et al. provide an early reflection stage that has a *unitary transfer function matrix* and also provides outputs such that *the overall system has a power gain that is substantially constant with frequency to improve the stability.*

Jot et al. uses various components and combines them in a different manner than the Applicant's claimed sound processor in order to simulate virtual sound sources. For example, the Jot et al. system adds reverberation to early reflections. Therefore, the resulting transfer function is not unitary. This is appropriate because the unitary property is not required for the application to which the Jot et al. system is directed. The Jot et al. system would not be applicable to the field of the Applicant's claimed invention (sound systems employing both loud speakers and microphones where acoustic feedback and instability is possible) because the Jot et al. system would increase sound system instability compared to a sound system that includes the Applicant's clamed sound system processor.

Claims 13 and 18

Claims 13 and 18 define an early reflection enhancement system and a method of enhancing acoustics with an early reflection enhancement stage, respectively. Claims 13 and 18 define an early reflection generation stage which, for example, could be used in a sound system processor. The purpose for the claimed early reflection generation stage is the same as that described above relative to Claims 1 and 8.

In Claims 13 and 18, an early reflection generation stage is defined that has a *unitary transfer function matrix that provides an overall power gain that is substantially constant with frequency*, the early generation stage comprising *a series connection of two or more cross-coupling matrices which are orthonormal matrices.*

Jot et al. does not describe the Applicant's claimed early reflection generation stage as set forth in Claims 13 and 18. The room module shown in Figure 9 of Jot et al. only includes one cross-coupling matrix that may be associated with an early reflection stage. The additional cross-coupling matrix (744) shown in Figure 9 is for the purpose of generating reverberation, *not* early reflection. Therefore, if matrix 744 is considered, the subsystem does not include an early reflection generation stage that outputs reflections, but rather another type of output including a combination of reflections mixed with reverberations. Further, the overall transfer function matrix of the early reflection and reverberation sections is not unitary to provide an overall power gain substantially constant with frequency. Therefore, the room module of Jot et al. does not have a series of matrices and delays as called for in Claims 13 and 18 and cannot provide the benefit of enhanced reflections which are provided by the Applicant's claimed early reflection enhancement system and method as set forth in Claims 13 and 18.

Advantages of the Applicant's Claimed Invention

The Applicants note the following significant benefits of their claimed present invention. In the known sound systems, such as that described in Jot et al., in which the reflection stage or subsystem is not constant with frequency, there is serious risk of coloration or other instability occurring during operation of the sound system. A key limitation in the known sound systems for live performances is the risk of instability caused by the feedback of sound from the loudspeakers to the microphones. Significant effort has been made by sound engineers to maximize the amplification of the sound system without the production of ringing tones (coloration), or instability, which produces the well-known, loud screeching sound that can damage hearing. Hitherto, the primary technique used for controlling sound system instability has been to keep the microphones away from the loudspeakers in order to reduce the "loop gain". A second method is to use equalizers to reduce the loop gain at frequencies where ringing occurs.

In the sound system applications of relevance to the Applicant's claimed invention, the sound detected by the microphones is enhanced by adding early reflections. However, the known early reflection stages such as that described in Jot et al. increase the variation of the loop gain and as a result, the stability of the sound system is degraded. The present invention is directed to solving the problem of such instability in sound systems.

The Applicant's claimed system and method as set forth in the present application overcomes those problems. The Applicant took the inventive step of ensuring that the sum of all output powers across all output channels equals the sum of all input powers, at every frequency, so that the total power gain of the system is a constant with frequency. The resulting unitary system has no deleterious effect on the loop gains and the stability of the sound system is not compromised.

The Applicant's claimed sound system processor and method as defined in Claims 1, 8, 13, and 18 respectively, are novel and nonobvious relative to the apparatus and method described and shown in Jot et al. The claims have been amended to clarify the inventive features. The claims now define a sound system processor including an early reflection generation stage that has a *unitary transfer function matrix* such that the sound system processor has an *overall power gain that is substantially constant with frequency to improve stability in the sound system*. The cited reference does not describe a system processor in which the overall power gain is substantially constant with frequency (that is, output power divided by input power), and further does not describe a system processor that also improves stability in the overall sound system. For all of the foregoing reasons, it is believed that Claims 1, 8, 13, and 18 are allowable over Jot et al.

The Dependent Claims

Claims 3-7 are dependent from Claim 1 either directly or indirectly and thus include all of the features set forth in Claim 1. Therefore, Claims 3-7 are allowable for at least the same reasons as Claim 1.

Claims 10-12 are dependent from Claim 8 either directly or indirectly and thus include all of the features set forth in Claim 8. Therefore, Claims 10-12 are allowable for at least the same reasons as Claim 8.

Claims 15-17 are dependent from Claim 13 either directly or indirectly and thus include all of the features set forth in Claim 13. Therefore, Claims 15-17 are allowable for at least the same reasons as Claim 13.

Claim 20 is dependent from Claim 18 and thus, includes all of the features set forth in Claim 18. Therefore, Claim 20 is allowable for at least the same reasons as Claim 18.

35 USC 103(a): Claims 6 and 7

The Examiner rejected Claims 6 and 7 under 35 USC 103(a) as being unpatentable over Jot et al. in view of WO 93/23847. The Applicant submits that WO 93/23847 does not disclose the features of the Applicant's claimed system that are missing from Jot et al. Therefore, the proposed combination would not anticipate the Applicant's claimed system as set forth in Claims 6 and 7. Accordingly, it is believed that Claims 6 and 7 are allowable.

CONCLUSION

In view of the foregoing amendments and remarks, it is believed that this application is now in condition for allowance. The Examiner is respectfully requested to reconsider the application in the light of the amendments and remarks presented hereinabove.

Respectfully submitted,

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